

## Phase I Project Summary

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**Firm:** Michigan Aerospace Corporation

**Contract Number:** NNX11CD62P

**Project Title:** SR-CATS: A Short-Range Clear Air Turbulence Sensor

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### **Identification and Significance of Innovation:** (Limit 200 words or 2,000 characters whichever is less)

SR-CATS (Short Range Clear Air Turbulence Sensor) is a short range molecular air data instrument, to detect and measure turbulence within an aircraft length ahead of the aircraft, as a component of a predictive gust alleviation control system. The instrument is designed to provide not only a look-ahead capability to predict near-aircraft turbulence but also provide a full air data solution (airspeed, angle of attack, angle of sideslip, and pressure).

### **Technical Objectives and Work Plan:** (Limit 200 words or 2,000 characters whichever is less)

The objectives of this Phase I effort were threefold. The first objective was to determine the performance specifications and instrument constraints to provide an in-flight turbulence hazard detection system. The second objective was to determine the capability and performance of the proposed system. Finally, the third objective was to develop the necessary system design to simultaneously make range-resolved measurements of winds immediately ahead of the aircraft at fine enough resolution to resolve turbulence, wind shear and gusts.

The work plan included trade studies, instrument design and engineering model design to test the concept in Phase 2. In addition, a risk matrix outlining technical, managerial and scheduling risks that might impact the program was formulated.

### **Technical Accomplishments:** (Limit 200 words or 2,000 characters whichever is less)

During this Phase 1, the trade studies were conducted and a conceptual design was derived from the studies. An engineering model design was completed for fabrication and testing in Phase 2. A test plan was also prepared.

### **NASA Application(s):** (Limit 100 words or 1,000 characters whichever is less)

SR-CATS will allow NASA aircraft the benefit of having a clear-air turbulence detection system for predictive gust alleviation control and an optical air data system in one package, suitable for general use by NASA aircraft as well as for flight research concerning clear-air turbulence and scientific studies of atmospheric processes. Ground-based uses include measuring wind speed and direction simultaneously with air temperature and density while also detecting and characterizing shear and turbulence. Potential uses include wind shear detection for space launches, wake vortices detection and characterization for airports, and climate change studies.

### **Non-NASA Commercial Application(s):** (Limit 200 words or 2,000 characters whichever is less)

Clear-air turbulence represents a significant safety hazard as well as passenger-comfort issue for the commercial airline industry. The proposed SR-CATS system has application not only as part of an automatic gust alleviation system, but also as an air data solution that alleviates many problems with current Pitot air data. This capability also makes SR-CATS extremely attractive for military aircraft, including fixed and rotary wing, high altitude and high dynamic, manned and unmanned, and even high-altitude airships. Information on winds near aircraft, if downlinked and compiled, will also be of significant value to forecasters, especially from aircraft flying over areas (oceans, etc.) where balloon radiosonde releases and other wind measurements are sparse or non-existent. NOAA and NASA identify the lack of more comprehensive wind-profile data as a major unmet data need for improving the accuracy of weather forecasts. Inadequate atmospheric data (wind speed, direction, temperature and density) also has a significant negative impact along the entire wind energy value chain, including site assessment, operational farms, turbine control, and grid integration. Finally, military applications for artillery and munitions delivery, precision airdrop, and aircraft take-off/landing on ships can benefit from SR-CATS technology.

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